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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/965,370	09/26/2001	Hua Chung	APPM/6303/CPI/COPPER/PJS	6507

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Patent Counsel
Applied Materials, Inc.
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EXAMINER

FULLER, ERIC B

ART UNIT PAPER NUMBER

1762

DATE MAILED: 11/26/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/965,370

Applicant(s)

CHUNG ET AL.

Examiner

Eric B Fuller

Art Unit

1762

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-69 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-69 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 2, 8-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Barth et al. (US 2002/0086523 A1).

Barth teaches in paragraph [0040] a process that deposits a barrier layer by CVD, deposits a seed layer that comprises copper and aluminum by CVD, and deposits copper over the seed layer by CVD.

Claims 1, 2, and 8-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Farrar (US 2002/0127845 A1).

Farrar teaches a process that deposits a barrier layer by PVD [0026], deposits a copper-aluminum alloy seed layer by PVD or CVD [0027], and deposits copper over the seed layer by electroless plating deposition [0029].

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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Claims 1, 2, 8-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Barth et al. (US 2002/0086523 A1).

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Farrar teaches a process that deposits a barrier layer by PVD [0026], deposits a copper-aluminum alloy seed layer by PVD or CVD [0027], and deposits copper over the seed layer by electroless plating deposition [0029].

Claims 1, 2, 8-14, and 42-46 rejected under 35 U.S.C. 102(e) as being anticipated by Pavate et al. (US 2002/0088716 A1).

Pavate teaches the limitations to these claims in paragraphs [0037-0039]. In claim 6 of the reference, the copper to aluminum concentration of the seed layer is taught. This is within the applicant's claimed range.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-10, 15, 16, and 20-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,290,833 B1).

Chen teaches depositing a barrier layer in a trench by CVD or PVD (column 5, lines 25-30). A first seed layer of copper alloy or aluminum alloy is deposited by CVD or PVD within the claimed sidewall coverage (column 3, lines 55-65; column 5, lines 45-50). The seed layer is enhanced by depositing an additional seed layer of copper (column 6, lines 4-15). Electroplating is used to deposit the bulk copper on the seed layers (column 6, lines 35-58). Although the reference fails to explicitly teach a copper alloyed with aluminum as the seed layer, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use such an alloy with

reasonable expectation of success, as Hideki teaches the equivalence of depositing TiN barrier layers by CVD or ALD.

Claims 59-62, 68, and 69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pavate et al. (US 2002/0088716 A1) in view of Hideki (US 6,294,425 B1).

Pavate teaches the limitations shown above. Pavate fails to explicitly teach depositing the barrier layer by atomic layer deposition. However, Hideki teaches the equivalence of using CVD or ALD in depositing barrier layers of the same material (column 12, lines 42-50). Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to utilize ALD to deposit the barrier layer in the process taught by Pavate. By doing so, one would have a reasonable expectation of success, as Hideki teaches the equivalence of depositing TiN barrier layers by CVD or ALD.

Claims 64-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,290,833 B1) in view of Hideki (US 6,294,425 B1), as applied to claim 63 above, and further in view of Pavate et al. (US 2002/0088716 A1).

Chen, in view of Hideki, teaches the limitations of claim 63, but fails to explicitly teach the aluminum concentration in the copper alloy seed layer. However, Pavate teaches using .01 to 10 weight percent of aluminum. It would have been obvious at the time the invention was made to a person having ordinary skill in the art to use this

concentration in the process taught by Chen, in view of Hideki. By doing so, one would have a reasonable expectation of success, as both references are concerned with forming seed layers for copper layers that conformably fill trenches.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Braeckelmann et al. (US 6,218,302 B1) and Wang et al. (US 6,447,933 B1) are cited for teaching the atomic concentration of the dopant in the copper alloy seed layer. Kaloyeros et al. (US 6,534,133 B1) is cited for being pertinent to the applicant's disclosure.


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B Fuller whose telephone number is (703) 308-6544. The examiner can normally be reached on Mondays through Thursdays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck, can be reached at (703) 308-2333. The fax phone number for the organization where this application or proceeding is assigned is 703 872-9310.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.



EBF



TIMOTHY MEEKS
PRIMARY EXAMINER